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The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

VOL. XLVII
No. 1208

SATURDAY, AUGUST 22, 1942
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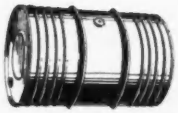

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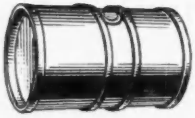

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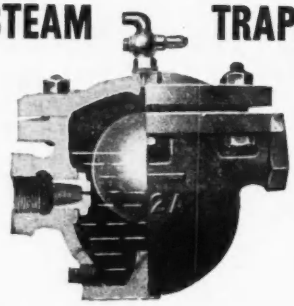

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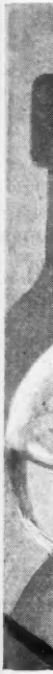

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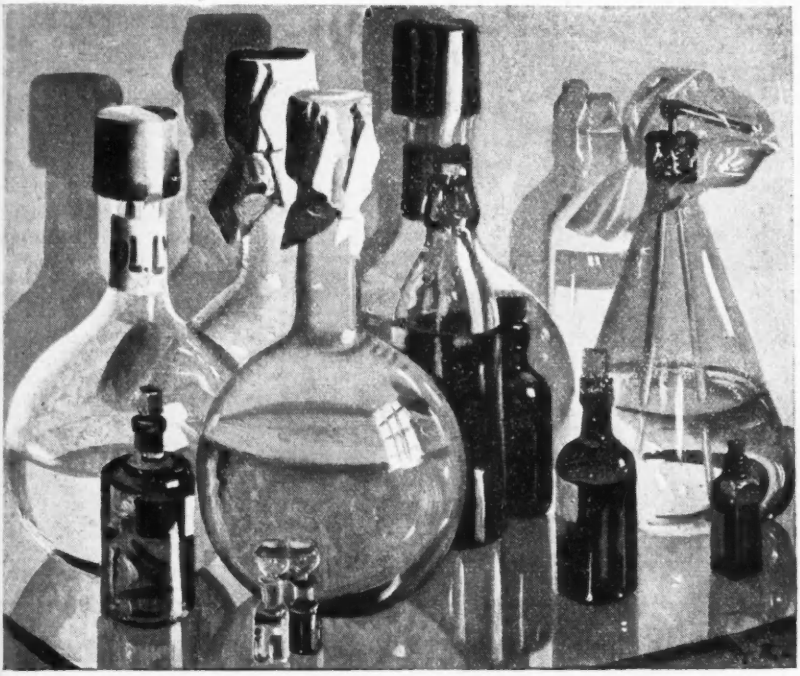
Aspects of an Industry



THE DISPENSARY

THE part played by the British chemical industry in the discovery and preparation of healing drugs and specifics is fundamental. It is not perhaps as obvious. That is, people do not readily associate the soda bicarbonate they buy, or the sulphanilamides that the doctor prescribes, with the limestone, salt and coal which are the raw materials of the great chemical factories. The apothecaries of old made their extracts, decoctions and elixirs chiefly from vegetable substances. These were given to patients without any precise knowledge of what their effects would be. About a hundred and fifty years ago the science of pharmacology began to be developed. The pioneers tried out their discoveries on animals and even on themselves. This method of trial and error sometimes had painful results, and one of the fathers of the science, William Alexander of Edinburgh, nearly killed himself. Nowadays the research chemist, the pharmacologist and the medical practitioner work together to perfect new drugs with new effects and special properties. The great majority of these are organic compounds, many of them the result of research in the dyestuffs industry. Suramin, to give one example, a specific for African sleeping sickness, was discovered as a result of the biological examination of dyes related to Congo Red—one of the earliest synthetic dyes, which is still used for the bright garments of the East. Modern drugs are largely synthesised from coal tar, from which substances like benzene, toluene and naphthalene are first obtained. These are next modified and combined with other chemicals by the research chemist. There are few industrial chemicals produced today which are not used at some stage in the preparation of drugs. The chemical industry is the basis on which the British research chemist is building up a constantly increasing supply of new and better drugs.

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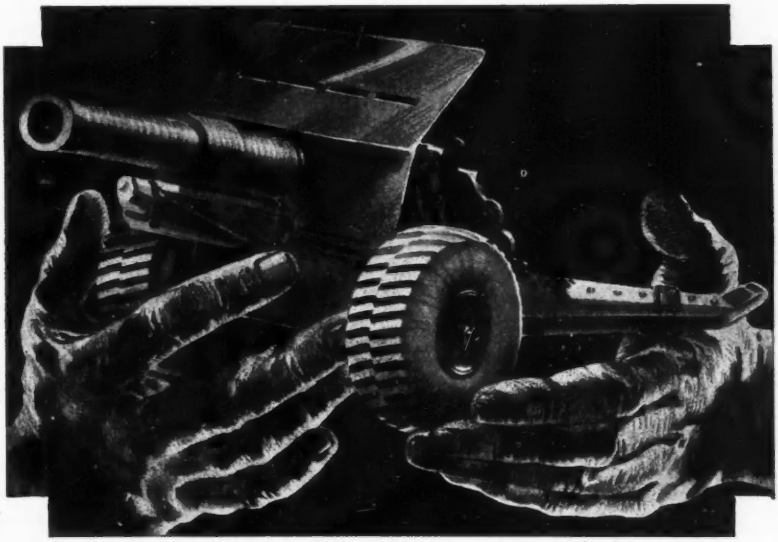

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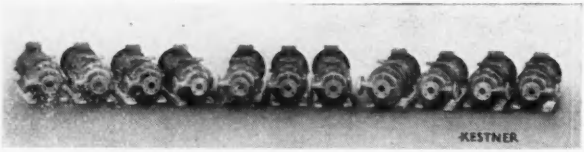

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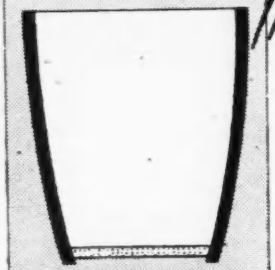

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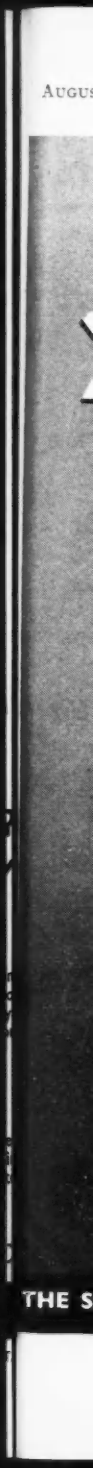
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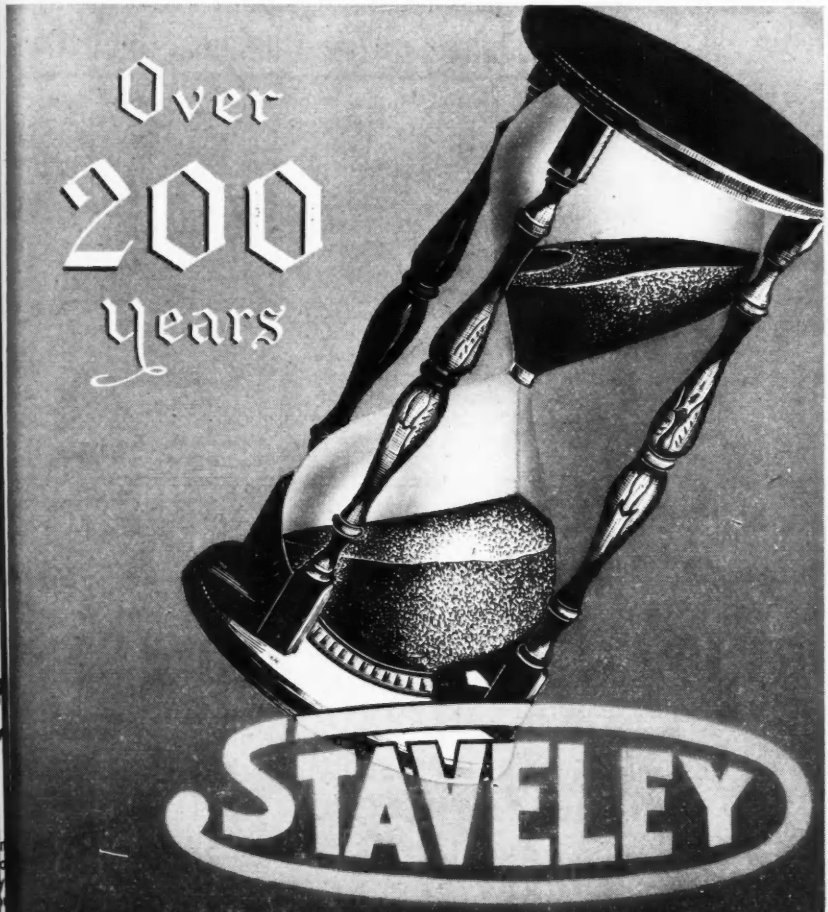

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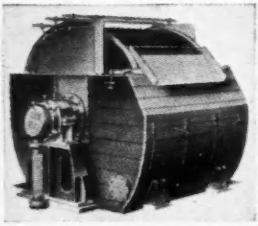

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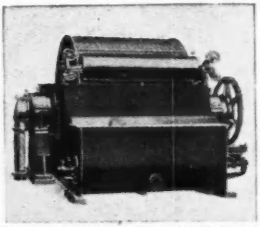

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Plain Words to Chemists

CHEMISTS are so accustomed to hearing themselves described in eulogistic terms, and the power of chemical research exhalted on high, that it will do them a great deal of good to study carefully Sir John Russell's Messel Lecture to the Society of Chemical Industry. Sir John was speaking primarily of chemistry in relation to agriculture, but many of his pungent comments are equally applicable to all branches of the chemical profession in relation to industry. In the foundation of the application of chemistry to agriculture there was in truth very little chemistry. As Sir John remarked, "it is rather chastening to reflect that most of the big advances in agricultural practice have been empirical and that frequently the scientist only came in later to prove what by that time every farmer knew." The truth of this comment is by no means confined to agriculture.

The only major result of chemical research in its application to agriculture has been the discovery of artificial fertilisers. That, indeed, is a major discovery of the first magnitude and has been followed by the discovery that plants can be grown in chemical solutions without any soil at all. But since the setting up of the artifical fertiliser industry, the applications of science to practice have not kept pace with the remarkable developments in agriculuture that have taken place in recent years. Agriculture appears to be a branch of human activity in which the chemist is still engaged in patiently discovering the basic facts and in ascertaining the reason for the success of proved agricultural practices. Sir John Russell thus addresses chemists not only from the standpoint of modesty, but also with the background of a struggling branch of chemistry that is seeking to find means whereby it can achieve the best results for the great industry which it is attempting to serve.

Sir John has interesting comments to make on the administration of research. There is a tendency, likely to be fostered by the war, of thinking solely in terms of organised research and of placing every individual in a team. Time alone, in Sir John's view, can show how far central organisation is effective. "The greatest discoveries of the past have been achieved where the research worker has had complete freedom, sometimes even in the face of high expert opinion."

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There are many instances in which investigations rejected by an expert committee have proved fruitful; and conversely subjects favoured by experts have given little or no result. "Obviously," says Sir John, "public money cannot be squandered on freak investigations, but it is essential to encourage the enthusiasm that overcomes all obstacles and achieves success in the face of apparently insuperable difficulties, and to retain the liberty which alone can ensure the constant advancement of science." There is a clear warning here against over-administration. Research associations must be carefully directed in order to retain the liberty and power of the individual worker to follow individualistic lines of research which often lead to far-reaching discoveries due to individual genius.

How to keep the individual research worker or research organisation fully alive, to prevent it from going stale, is a pressing problem on which Sir John Russell has something to say. He claims that research faculties tend to decay after the age of 50, a far-reaching generalisation that is at least debatable. "The research faculty," he says, "is fairly widespread among young people. But only the exceptionally gifted retain it for long. It is most unusual for a man to strike a new line of work after the age of 50, and for many the curtain falls sooner." Is not the truth of the matter that except for a few fortunate or gifted research workers the pay is not sufficiently attractive to keep their whole activities based on their individual researches? Is it not the common practice in industry for scientific men of high ability to find that they are switched on to work of an administrative character, so that the opportunities for imaginative research disappear after the age of 50, and for many individuals at an even earlier age? The problem of keeping the brains of these men energised is very great. Many novelists continue to write imaginative work in their later years, and on this analogy we are disposed to believe that the decay of the research faculties in later years is rather the consequence of environment than of the working of natural laws. Sir John points out that a change of employment frequently brings with it a new outlook through new human contacts, and he believes it is desirable to facilitate and encourage movement from one service to another. This does not mean so much a haphazard shifting from one firm to another as an organised exchange of scientific men from one type of work to another and frequently from home to overseas and vice versa.

NOTES AND COMMENTS

American Chemical Meeting

AMERICA is a country in which we expect things to happen in a big way. But even if this rule is not invariable, the Americans never make the mistake of not preparing for big things. We have just read a notice in a United States journal warning those planning to attend the autumn meeting of the American Chemical Society on September 7, to make reservations early and buy tickets well in advance of departure; otherwise it might be impossible to secure accommodation on the trains. The notice adds, unnecessarily, that a large and important meeting is anticipated. It makes odd reading to one who was present at the recent rather thinly-attended meeting of the Society of Chemical Industry until it is remembered that in this country the call-up into the Forces is in a much more advanced stage as is, apparently, the absorption of people into essential occupations which do not allow them the time to attend conferences. We should like to think, too, that many members of our chemical societies consider a journey to London to be unnecessary in these times, when the industry's Press gives extensive reports of the proceedings. Still, we cannot but admire the enthusiasm which envisages so great a strain on the American railway system from the supporters of a chemical meeting.

S. R. & O.

A CORRESPONDENT of the *Liverpool Daily Post* has voiced a complaint which, we must confess, seems to us to be fairly well justified. Referring to the continuous flow of Statutory Rules and Orders emanating from various

Government departments, as the form in which "a large part of the laws at present afflicting us are cast," he states the generally acceptable proposition that laws are only tolerable when they are readily ascertainable. His main protest lies in the accusation that many of these "rules and orders" come into force before copies are obtainable through the usual channels, and he argues that it is a sign of gross inefficiency on somebody's part if an order coming into force on (say) August 1 cannot be seen, at any rate in the provinces, until August 7. Trade journals, as he says, do their best to give forecasts of these orders, but for the traders concerned it is usually necessary to study the full text of the rules. This complaint, we contend, is a serious matter, and any Government department with an uneasy conscience should certainly take steps to hasten the publication of its orders; it should in fact ensure that such orders are ascertainable *before* they come into force. The letter goes on to say that it is doubtful whether a number of these orders are really necessary, and suggests that some of them are merely issued to save their originators a little trouble. That is another affair, but the main issue is not affected: whether essential or not, every new rule should be published in plenty of time to allow of full study before the need for action.

"Potassium from the Sea"

IT is reported from Scandinavia that a new reagent for potassium has been discovered which enables that element to be extracted commercially from the sea. The Americans have for some years been extracting bromine from sea water and recently both the U.S. and Japan have begun the preparation of magnesium from this source. It is recognised that in time of war the term "extracted commercially" may have a different meaning from that admitted in times of international competitive trade, but, considering the ease with which potassium can be obtained from other sources it is, to say the least, doubtful whether, even allowing for the necessities of warfare, it would be worth while to do this. The process would have to be even cheaper than that used for the recovery of bromine and magnesium which are normally less accessible than potassium.

Chemistry and the Arts

A WRITER in the *Birmingham Post*, recording the fact that Shelley was born 150 years ago, relates how the poet, in common with other men prominent in the arts, had a deep interest in chemistry. As a student he was known as "Mad" Shelley and was deprived of a book on chemistry on the grounds that such things were forbidden at Eton. The writer says that Goethe had his furnace and later became quite professional with his analyses of well-water and medicinal salts, while Swedenborg for a time studied copper, tin, brimstone and vitriol, hot springs and salt-making. Among the musicians Borodin, we are told, became a chemist of the first rank because he was advised not to waste too much time on music. If in the past writers and musicians turned their attention to the pleasures of experiment in chemistry and other sciences, the position has been reversed in the present age when science and chemistry are made popular reading and at least one scientist has written a controversial book about music.

Wholesale Prices in July

THE index figure, published by the Board of Trade, for wholesale prices in July, shows little change, so far as the chemical and allied trades are concerned, over the corresponding figure for June. Chemicals and oils actually reveal a small decrease of 0.1 per cent. and stand at 134.4 (1930 = 100); in this group there were declines in the prices of fertilisers, sulphate of ammonia and superphosphates showing falls of 4½ and 5 per cent. respectively, while drugs in the salicylic acid and quinine group were a little dearer. Iron and steel (182.7) and non-ferrous metals (126.0) were stationary, but the index figure for coal rose 10½ per cent. to 179.9, thanks to the all-round increase of 3s. per ton on July 3.

Scrap Collection Delays

THE fuel economy campaign has got off the mark well and already the results are by no means negligible. There is, however, a long way to go before we can even suggest that we are out of danger of rationing. During the coming months there is bound to be a crescendo of publicity in support of the urgent need of restricting fuel consumption. The

danger is that we may become one-track minded in this respect to the neglect of other important calls on our attention. It is difficult to give equal prominence to all matters of importance and it must be left to public commonsense to see that if a need for special economy in a new direction is stressed, this in no way lessens the urgency of saving in the old ways to an even greater extent than before. In some parts of the country far too much scrap is still lying about yards and factories. The complaint is heard that many brokers are inundated and cannot deal fast enough with the amount coming in. If this is used as an excuse for hoarding it is an argument on wrong premises. The fact that scrap has gone to the broker is sufficient to have set the wheels of salvage in motion. The authorities can always find it in the broker's yard, but not in odd corners of hundreds of workshops scattered far and wide.

Germany's Salvage Drive

SIR James Marchant has again stressed the need for handing over every piece of metal, pointing out that in Germany during the last six months the salvage drive has been greatly intensified. Copper, nickel and silver coins, church bells, metal from public buildings, and even brass fittings from policemen's helmets have been surrendered. There is some small comfort in this information. It is a pointer to the all-out drive, staking everything on quick victory, which is Germany's policy. But, if we are still at the park-railing stage, it is not due to a surplus of raw materials by any means, but rather to a serious leeway in the rendering and collection of salvage which must be made up quickly.

AMERICAN NOTES

Magnesium Metal Production

REFERENCES to the use of ferro-silicon in the thermal production of magnesium metal have been appearing fairly frequently in the American Press of late. It now appears that this process was discovered by Dr. L. M. Pidgeon, of McGill University. Little authoritative detail on the method has yet been made public, but apparently both U.S. and Canadian metallurgists are convinced that it represents the safest and most efficient means so far devised for the thermal reduction of magnesium oxide. Important new plants for making magnesium by the ferro-silicon process are under erection in both North American countries, and it is reported that the plant at Permanente, California, originally designed to operate by the Hansgirg carbo-thermal reduction process, which has been the scene of a number of explosions, is to be converted to the Pidgeon method.

Talc for Defence

While the civilian defence authorities in the U.S.A. mention talc for fighting fires caused by incendiary bombs, E. M. Peavy, writing in the *American Chemical and Engineering News*, points out that little stress is laid on its use although, he says, it is helpful against all sorts of incendiary bombs and has many special advantages. In the first place, the writer suggests, its covering power, volume for volume, is far better than that of sand. Although it has a tendency to float on air currents, it adheres so firmly to whatever it touches that only a comparatively small volume need be used. Hence, it extinguishes a fire very readily. Secondly, it adheres to magnesium particularly well and is very efficient for extinguishing burning magnesium. It is far safer and more effective than a water spray. It actually extinguishes the bomb instead of merely hastening the burning. Then it will extinguish oil, and will float on kerosene, etc., until it has adsorbed much oil. Lastly, he says, it will adhere to phosphorus sufficiently to make a bomb of this material safe until it can be properly disposed of.

Galvanising Substitute

The Coated Products Corporation, Pittsburgh, has been formed for the purpose of promoting a substitute protective coating on steel and has introduced a method of weatherproofing pre-fabricated metal. This process, by the utilisation of pitch, can be employed in place of galvanising for protecting metals against corrosive atmospherii conditions, thus releasing valuable zinc. The process uses "Plastipitch," a pitch that is claimed to possess improved plastic characteristics. The coating is applied by the dipping method. Anticipating the possibility that steel may not always be available for such uses, a substance, developed from waste industrial fibres, will be produced by a large rubber company. This substance can be substituted for steel or bonded with steel, and when coated with "Plastipitch" it could be used for roofing and other constructional purposes, or for insulation.

Recent Developments in Analytical Chemistry—II

(From our Analytical Correspondent.)

A SECTION of the most recent *Annual Reports on the Progress of Chemistry*[1] is devoted to enumeration and review of methods for the detection and determination of the alkali metals, with special reference to methods published within the last half-dozen years. Important among chemical methods of estimation discussed are the use of double uranyl acetates for the determination of sodium, and the precipitation of potassium as cobaltinitrite. The outstanding physical methods applied to this group are colorimetry and spectrography. Arc, spark, and flame spectrum procedures are dealt with, and under the heading of flame spectrography both the Ramage and the Lundegardh techniques are discussed.

Potassium Estimation

More recently the estimation of potassium has been investigated by several workers. Sodium cobaltinitrite is recommended as reagent by Wander,[2] but instead of terminating the estimation gravimetrically his aim has been to shorten the process by colorimetric measurement. The potassium, precipitated in the presence of a little nitric acid, is allowed to stand a fixed time (two hours is suggested) and the centrifuged precipitate is washed in the centrifuge tube with dilute nitric acid. Treatment of the washed precipitation *in situ* with standard potassium dichromate results in a clear solution whose colour lies within the range yellow to green, and depends on the extent of reduction of the dichromate. The colour, which is stated to be quite stable, is estimated photometrically in the region 4250 A.U., and the reading converted to a potassium value with the aid of a calibration curve. Only ammonium ions (at least among those usually encountered in the analysis of plant ash) interfere with the determination. A variation of this procedure which also terminates colorimetrically has also been described.[3] This depends on treatment of the potassium cobaltinitrite with choline chloride and sodium ferrocyanide. The resultant colour is compared with that obtained from a standard cobalt solution.

As an alternative to colorimetry, a perchlorate method has been recommended[4] for the determination of the metal in silicate rocks. The sample is digested with a mixture of perchloric and hydrofluoric acids, hydrofluosilicic acid being subsequently removed by steam distillation. The solution is then evaporated to very small bulk. Extraction with ethyl acetate leaves behind only the insoluble potassium perchlorate and residual silica. The latter is easily eliminated by extracting the perchlorate with hot water. The dried potassium perchlorate from the filtrate is once more treated with ethyl acetate, dried at 310° C., and weighed. St. John and Midgley[5] digest biological material with a perchloric-nitric acid mixture, but complete the estimation by a final precipitation of the potassium as chloroplatinate, following removal of metals such as iron and aluminium. Washing the chloroplatinate with ethyl alcohol removes the calcium, magnesium and sodium salts.

Sodium and Lithium

The determination of sodium with zinc uranyl acetate may be concluded colorimetrically,[3] since the complex precipitate, when dissolved in acetic acid, gives a colour with potassium ferrocyanide, due to the uranium. The unknown solution is compared with similarly treated sodium standards. In silicate rocks[4] it is possible to carry out a preliminary evaporation with hydrofluoric acid, removing fluoride in a further evaporation with sulphuric acid, and then to proceed directly to a double uranyl acetate precipitation of the sodium.

If it is desired to estimate lithium in the presence of sodium or potassium (or *vice versa*) it is usual to extract a mixture of the chlorides with *iso*-amyl alcohol. Research on the solubilities of these chlorides had shown[6] that one of the octyl alcohols, 2-ethyl hexanol (technical grade), is much more suitable. While all three chlorides have a lower solubility

in this solvent, lithium chloride is still sufficiently soluble (3 per cent. at 25° C.) to be extracted, so little of the sodium or potassium chloride being removed that it is unnecessary to apply a correction for solubility. As the boiling point of the solvent is high, dehydration of the sodium or potassium chloride is a simple matter.

Heavy Metals

To estimate copper in steels[7] the alloy is first dissolved in a mixture of nitric and hydrochloric acids, and these acids are then removed completely by boiling with perchloric acid. The solution is diluted with water, freed from chlorine, and neutralisation with ammonia is effected. Acidification with sulphuric acid and phosphoric acid is followed by electrolysis. Deposition of the copper is aided by the added phosphoric acid, and it is most convenient to use a high current density without stirring the solution during the electrolysis. It is claimed that this method of estimation is suitable for inclusion in a straightforward scheme for the consecutive estimation of silicon, phosphorus, manganese, chromium, copper, and nickel in steels, with the minimum of manipulation.

Two papers deal with the estimation of traces of copper in alcoholic liquors and their by-products. Since iron is usually also present, Stone[8] prevents interference by forming the $\alpha:\alpha'$-dipyridyl complex of the iron; this will not react with the recommended copper reagent, sodium diethyl dithiocarbamate. Therefore the copper complex alone is extracted by a solvent such as amyl acetate. Photometric determination is recommended, using the wavelength 4400 A.U. for smaller quantities of copper (0.02 to 0.10 mgm.) and 5400 A.U. if the amount of copper lies in the range 0.1 to 0.5 mgm. A similar device is somewhat extended by the other paper,[9] so that simultaneous estimation of the iron is possible. The two reagents ($\alpha:\alpha'$-dipyridyl and sodium diethyl dithiocarbamate) are added together, and the solution is shaken with *iso*-amyl alcohol. Separation of the two complexes is thus achieved, the yellow copper complex passing into the alcohol layer, while the pink iron complex remains in the water layer. The region 4500 A.U. is suggested for photometric estimation of the copper, and 5000 A.U. for the iron.

Copper may be separated satisfactorily from lead by salicylaldoxime.[10] At the methyl orange end point the pH is suitable for precipitation of the copper. It is best to neutralise the acid solution carefully, after addition of the reagent, with ammonia. The precipitate is filtered off after half an hour. If the solution is now made strongly ammoniacal, and ammonium nitrate added, lead is precipitated quantitatively, and may be filtered off after an hour.

Diphenylthiocarbazone (dithizone) has been put forward as a suitable colorimetric reagent for lead in sugar products,[11] the range of concentrations covered being from 0.5 to 5.0 parts per million. Since this reagent is affected by a number of metals, Biefeld and Patrick[12] have determined the most suitable conditions for its general use in the estimation of lead. The reagent must be present in large excess, with as low a pH as is feasible. To prevent precipitation of other metals, citrates are often added, but this practice should be avoided, tartrates or preferably acetates being used instead.

Palladium

Two methods for the estimation of small amounts of palladium have recently been proposed. In the former[13] the hydrochloric acid solution is treated with stannous chloride, which produces a brown colour. A layer of benzene is added, and the whole is titrated against a standard solution of sodium diethyl dithiocarbamate. The palladium complex thus formed is benzene-soluble, so that shaking transfers it progressively into the benzene layer. The exact end-point cannot be observed in this manner, however, and increased sensitivity is obtained by adding a trace of mercuric chloride when the water layer has become almost colourless. An intensely coloured red-brown complex is produced in the water layer. This also reacts with the sodium diethyl dithiocarbamate to give a benzene-soluble product, so that continued titration until the water layer becomes completely colourless removes all the palladium into the benzene layer, the amount originally present being indicated by the total added amount of the standard reagent. The other method for the determination of palladium recommends the use of β-furfuraldoxime, and is a gravimetric method.[14] Several

aldoximes have recognised analytical uses, formaldoxime being used as a reagent for manganese and nickel, salicylaldoxime for copper and nickel. The usual modern gravimetric reagent for palladium is dimethyl glyoxime, better known in its application to nickel determinations; so it seems reasonable to expect that aldoximes, since they react with nickel, might also react with palladium. In actual fact it is found that β-furfuraldoxime is more effective than dimethyl glyoxime as a palladium precipitant. From a hydrochloric acid solution, a 2 per cent. solution of the reagent precipitates a yellow compound with a composition corresponding to $Pd(C_4H_3O.CH:NOH)_2Cl_2$, which, when washed with cold dilute hydrochloric acid and water, is suitable for weighing. The precipitate is easier to manipulate than the palladium-dimethyl glyoxime complex, and has an even better conversion factor, so that rapid and accurate determinations are possible. Out of a large number of metals examined for possible interference, only gold, silver, mercury (in the mercurous form), lead, and quadrivalent cerium were found to have an adverse effect.

Nitrates and Nitrites

For the estimation of small amounts of nitrite, as, for example, in water or in sulphuric acid, the use of a diazotisation reaction is of very long standing, and the most generally useful one has long been considered to be that in which the "Griess Reagent" is employed—*i.e.*, the coupling of α-naphthylamine with sulphanilic acid by the agency of liberated nitrous acid.[15] The estimation is colorimetric, depending on the depth of colour of the resulting coupled compound. More recently[16] in an investigation of a large range of diazo reactions, Shimm decided that the coupling of sulphanilamide with *N*-(1-naphthyl)-ethylene diamine was a much superior reaction to the Griess for the estimation of nitrite. In a recent paper[17] Shimm's procedure has been modified in order to make it suitable for the range of nitrite content usually met with in water analysis, *i.e.*, from about 0.001 to 0.015 parts of nitrite nitrogen per million. The final estimation after development of the colour may be made by any of the recognised colorimetric procedures.

The estimation of small amounts of nitrate in the presence of nitrite has always been a rather difficult operation. The methods most usually applied to small amounts of nitrate depend on the formation of a colour through nitration of an organic body (*e.g.*, phenol). Investigation has shown[18] that all these procedures give some colour with even the purest sodium nitrite. It is therefore necessary to destroy nitrite first, before proceeding to determination of nitrate. Sodium azide is the recommended agent for this purpose. On subsequent evaporation to dryness the residue is desiccated thoroughly, treated with a standard three drops of nitrobenzene and 0.35 ml. of sulphuric acid. Nitration to dinitrobenzene takes place in the cold, and, on addition of standard amounts of alkali and acetone, a violet colour develops which is not given by nitrobenzene alone. The intensity of the colour is a measure of the amount of nitrate originally present. By this means it is possible, starting with 0.1 g. samples of nitrite, to estimate amounts ranging from 0.1 to 1 per cent. of sodium nitrate.

Some New Reagents

The compound *o*-nitrosophenol promises to be useful as a quantitative reagent, and it has been recommended for the colorimetric determination of cobalt.[19] It forms complexes very readily with cobalt, palladium, ferrous and ferric iron, copper, mercury, nickel, and zinc. Shaking an organic solution of the reagent with an aqueous solution of the metallic salt for a few seconds is all that is necessary to produce the complex quantitatively. Of these complexes, those with cobalt, palladium, and ferric iron are soluble in petroleum ether, while the others are insoluble, so that a separation can be effected. It is possible to prevent interference from iron in the cobalt determination, and since the palladium complex is green, while that of cobalt is greyish brown, cobalt can be determined colorimetrically by employing suitable colour filters.

Rhodanine and its derivative *p*-dimethylamino benzal rhodanine have been in use for a number of years as reagents for several metals, more particularly for silver[20] A number of the hydroxy and dihydroxy derivatives have now been investigated[21] with a view to ascertaining their suitability as reagents. The 3:4-dihydroxy benzal rhodanine is stated

to be very sensitive, and to give complexes with a number of metallic ions; of these a specially suitable one is the lavender lake which is formed with nickel in alkaline solution. The usefulness of the reagent is, however, restricted by its limited solubility, so that only very dilute reagent solutions can be employed.

As a substitute for phenolphthalein in acid-base titrations sodium quinizarin-6-sulphonic acid has been proposed,[22] both from the point of view of cheapness and of sharpness of the colour change. The indicator covers the range of *p*H 7-11.5 with two colour changes, a sharp one from yellow at *p*H 7 to pink, and a more gradual one from pink to blue-violet at *p*H 11.5. The indicator is therefore suitable either for the colorimetric determination of *p*H over this range, or for the titration of strong bases against weak or strong acids. As an indicator for the determination of nitrogen by the Kjeldahl method, absorbing the evolved ammonia in boric acid solution and titrating against hydrochloric acid, a mixture of five parts of bromocresol green and one part of methyl red is put forward.[23] The indicator is bluish-purple in boric acid solution, but turns bluish-green when a trace of ammonia is added. On titrating with hydrochloric acid a very sharp colour change to pink takes place at the end-point, equally well visible in daylight and in artificial light. Use of this indicator permits of satisfactory results from the boric acid method on the micro scale. Previously the end-point was rather too diffuse for accuracy in a micro determination.

Polarography

In a general article, Kolthoff[24] considers a number of factors that need attention in quantitative polarography. He points out that it is generally preferable to remove oxygen from the system, since a solution saturated with air is about *N*/1000 in respect of oxygen, and reduction of this element produces two polarographic waves. The solvent and the temperature at which the determination is carried out affect the result, and must be allowed for. While usually a fairly large variation in the amount of indifferent electrolyte is permissible (from 0.02 to 0.5 molar), it is preferable that it should be present in at least fifty times the concentration of the ion to be determined. If, however, the amount of indifferent electrolyte is too great (higher than 0.5 molar), it is usual to get an anomalous wave which is attributed[25] to the electroreduction of water, and which is best eliminated by the addition of about 0.01 per cent. gelatine. The dropping time of the mercury cathode should be greater than 3 seconds, and a constant pressure should be maintained on the mercury to ensure reproducible results. Also, substances which form insoluble films at the cathode should if possible be avoided. The saturated calomel electrode is recommended as the most suitable reference electrode.

If, in a mixture containing two reducible ions, anomalous peaks such as those described elsewhere in this journal[26] arise from both of the ions, while their half-wave potentials lie close together, it is essential that the first maximum shall be suppressed before attempting an accurate determination, as otherwise the curve will not fall to the true diffusion current value before reaching the second maximum, and the value obtained for the concentration of the first reduced ion will be fictitious.

Various Estimations

Sodium or potassium may be estimated polarographically together with lithium if tetraethyl ammonium hydroxide is used as indifferent electrolyte in 50-80 per cent. ethyl alcohol solution.[27] If it is only required to determine the concentration of sodium or potassium, lithium hydroxide may be utilised as the indifferent electrolyte, the solvent being 80 per cent. ethyl alcohol. Small amounts of iodide (in photographic materials) have been determined[28] by precipitation as silver iodide, oxidation to silver iodate, destruction of the excess chlorine by phenol, and polarography above *p*H 7. Arsenic in biological substances is stated to be estimated more satisfactorily using the polarograph than by either the Gutzeit or Marsh test.[29] The arsenic, liberated as arsine, is collected in mercuric chloride solution. When this solution is heated it is converted to arsenous oxide and mercurous chloride; the latter can be removed by reduction with hydroxylamine in slightly ammoniacal solution. The resulting polarogram is interpreted by a calibration curve produced by a similar treatment. As well as in quantitative polarography, the

polarograph has been used[30] to determine the best conditions for the amperometric titration of phosphate with uranyl acetate, *i.e.*, the most suitable indifferent electrolyte and voltage for the titration. Complete details of the materials and mode of construction of a manual and a recording (photographic) polarograph have been published.[31]

Optical Methods

A report of a panel appointed to consider the use of spectrophotometric terms and symbols has recently appeared.[32] It points out that while a colorimeter is, precisely speaking, an instrument for *measuring* colour (*e.g.*, the Lovibond Tintometer, which expresses colour in unit values), and that so-called colorimeters are more often colour comparators, nevertheless usage seems to sanction this terminology. However, it is stressed that it is not desirable that the term "colorimeter" should be loosely applied to instruments used for measuring the amount of *absorption* of light, which are spectrophotometers if they cover a restricted range of wavelengths, and absorptiometers or densitometers if they cover a restricted range or deal merely with white light. The report also defines the formulæ, symbols, and terms to be used in dealing with the absorption of light.

The principles and uses of photoelectric fluorimeters are described by Lothian.[33] Although both colorimeters and absorptiometers or densitometers if visually for quantitative fluorescence measurements, an instrument utilising photoelectric measurements is obviously to be preferred. The instrument recommended by Lothian contains two photoelectric cells connected to a galvanometer by a null circuit. The light reaching these cells may be controlled by diaphragms, and on the adjustment of the diaphragms necessary to maintain the galvanometer reading at zero depends the estimation. The fluorimeter has been applied principally in biochemical quantitative analysis, but it is pointed out that other possibilities for its use exist, two prospective fields being the measurement of *p*H by fluorescent indicators and the quantitative estimation of phosphors in fluorescing materials.

Nephelometry has been applied[34] to the determination of the solubilities of carcinogenic and related hydrocarbons, when the solubilities are of the order of about 1 μg. to 2000 μg. per litre. It is suggested that the method might be extended to the estimation of small amounts of this order. The substance being dealt with is dissolved in acetone, and this solution is dispersed in water, the Tyndall effect obtained being compared with that of a standard in a suitable nephelometer. Dilution of the solution is carried out, and the amount of light scattering is plotted against dilution. It is then possible to determine from the curve the point at which there is no further reduction in the light scattering, that is, when all the hydrocarbon is dissolved and the Tyndall effect is the residual one to be expected from the solvent.

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Nearly doubling its output of the previous year, Manitoba's 35 plants engaged in the production of chemicals and allied products last year turned out goods to a gross value of $9,215,936. A preliminary federal report shows the combined staff more than tripled, rising from 603 to 2321.

Adhesion and the Action of Adhesives

A Neglected Problem of Physical Chemistry

by J. J. BIKERMAN

WHEN I break a solid—it may be an iron pipe, a wooden stick, or a glass rod—and join the ends, why don't they stick together again? We are so used to this absence of adhesion that we are inclined to overlook even the existence of a problem. But there is a problem. All known forces between atoms and molecules, whether they are due to free charges, to dipoles, to induction by electronic currents, or to another cause, produce reversible effects; if, say, a crystal lattice is separated in two halves and the halves are brought back into exactly the original position, the restored lattice should be exactly identical with the original one, and no trace of the cut nor weakness at the joint should be detectable.

The Chemistry of Fracture

The actual behaviour is, of course, very different. Two main reasons are advanced for it. The first is of the "molecular type." When a solid is broken in air the atoms next to the new surface become "unsaturated" and readily adsorb air molecules or react with oxygen or moisture of the air. In plain words: when I cut copper wire I really separate copper atoms from copper atoms; but when I join the ends together I only press one air cushion against another; as the adhesion of air to air is negligible the pieces fall apart. This cause undoubtedly exists but it is insufficient to explain, *e.g.*, the absence of adhesion between the pieces of a fractured solid when the fracture takes place in a good vacuum. Here the second cause appears to operate alone. It is of the "mechanical type." When a solid is broken, the surfaces of separation are neither flat nor smooth. When an attempt is made to put these surfaces together again, it is impossible—the precision of our movement is not sufficient—to place every protrusion on one surface exactly in that indentation of the other surface from which it was broken away. The result is that the new surfaces touch each other only in a few points, and the total area of contact is a very small fraction of the area of contact before the fracture. Therefore, the force required to separate the fractured body is only a very small fraction of that required to produce fracture.

Thus we account for the fact that copper does not stick to copper or wood to wood. But why does copper stick to solder? Why does wood stick to glue? From the "molecular" point of view the reply would be—because adhesive forces between copper and solder or wood and glue are stronger than between copper and copper or wood and wood. The answer given from the "mechanical" point of view is much more satisfactory. Solids can be brought into contact at a few points only; but when a liquid adhesive is applied to their rough surface, it can fill all the hollows and pores of the solid, thus establishing a contact along the whole surface of the fracture; if this contact is not impaired during the solidification of the adhesive, the area of contact between the fractured solid and the solid adhesive is as large as the area of the fracture itself; therefore the force of adhesion is strong. On this assumption the art of joining solids consists (a) in establishing a complete contact between the solid and a liquid adhesive, and (b) in maintaining this contact during the solidification of the adhesive.

When the adhesive does not wet the solid properly, the depressions on the solid surface remain filled with air, and the total adhesive force between glue and solid is small. A neat example is given by paraffin wax used as an adhesive for metals. If a drop of molten wax be placed on a brass plate at room temperature or even at, say, 30°-40° C., it does not stick to metal after solidification. In contact with cold brass the bottom surface of the drop has solidified so rapidly that the wax had no time to displace the air, grease, and moisture from the depressions on the brass surface. If the experiment is repeated with a brass plate raised to, say, 70° C. (*i.e.*, above the melting point of the wax), the wax remains liquid long enough to displace the air and "dirt," and adhesion between brass and wax becomes so strong that they cannot be parted again: when it is attempted to pull the wax blob from the plate, the wax breaks sooner than the wax-brass joint.

Condition for Stable Joints

When the solidification of the adhesive entails considerable volume changes it may sever the contact established when the adhesive was still mobile. A familiar example is the cracking of glass-metal joints when they are cooled down to room temperature; only when the thermal expansion of the metal (*e.g.*, platinum) is sensibly equal to that of glass can stable joints be prepared. When the solidification of the adhesive is a sequence of its drying—as in the case of many gelatin glues or cellulose ester solutions—the shrinkage associated with drying and the extensibility of the dry

film should be such that the film remains attached to the solid although this attachment causes a permanent extension of the film.

Naturally the above definition of the art of joining solids over-simplifies the matter. The solid and the adhesive may interact chemically (as in many silicate joints), the solid can swell or dissolve in the liquid adhesive, etc., but the production and maintenance of extensive contact seems to be the basic condition of a sound joint. When this condition is fulfilled, an attempt to separate the joined solid bodies generally leads to a fracture within the adhesive layer; the joints fail *in* the adhesive, not along the boundary between the adhesive and the solid body. (In the system wood/gelatin-glue/wood, the wood may break before the gelatin; at any rate no separation occurs between wood and gelatin). All recognised adhesive joints fail in this way. That does not mean that the force between two neighbouring molecules of solid and glue is greater than that between two molecules of the solid or of the glue; but, since the contact area between the rough surface of a solid and the adhesive layer is greater than the cross-section of this layer, when a pulling force is applied the stress (*i.e.*, the force per unit area) within the adhesive is greater than its boundary with the solid.

Ultimate Tensile Strength

Usually joints fail within the adhesive. What, then, determines the strength of a joint? The stress required to break a solid is termed its ultimate tensile strength. The strength of a joint would be expected, therefore, to be identical with the ultimate tensile strength of the solidified adhesive. This identity appears to be disproved in many instances, since the strength of the joint is often greater than that of the adhesive, but the discrepancy is only apparent. The strength of the adhesive itself is measured on large samples which may be many cm. long, whereas the adhesive layer is, generally speaking, very thin, say, 0.01 cm. or even less. Now, the ultimate tensile strength of a material as a rule is the larger the smaller the sample; a short cotton thread or a short wire is stronger than a long one. The same rule applies to adhesive joints; it is well known that thick joints are weaker than thin. If, therefore, a thin adhesive layer is compared with a large test piece of the same adhesive, its strength shows a higher value. It is generally assumed that the lower strength of longer threads is due to a higher probability of a very weak spot in a larger specimen, just as the probability of meeting a deformed person on the street increases when the total number of persons observed increases. The same reasoning can be applied to adhesive joints, and the theory of probability allows a calculation of the relation between the strength of thick and thin joints. Such calculations have been applied to data on the strength of paraffin-wax joints between metals (Bikerman, *J. Soc. Chem. Ind.*, January, 1941), and it was found that about two-thirds of the difference between thick and thin joints could be accounted for by probability considerations alone. The rest probably is due to the difference in the crystal size of thick and thin adhesive layers. Thin layers cool more rapidly than thick, and rapid cooling usually produces smaller crystals than does slow cooling, thus there is a tendency for the crystals of the adhesive to be small if the adhesive layer is thin. On the other hand it is known that the ultimate tensile strength of a material usually increases when its grain size diminishes. It is noteworthy that the recognised adhesives either do not crystallise at all (*e.g.*, gelatin, starch) or, under usual conditions, form very small crystals (*e.g.*, solders).

STEEL GAS CYLINDERS

The British Standards Institution has recently issued a further specification in the series of British Standards for Steel Cylinders for the Storage and transport of gases. The present specification relates to manganese steel gas cylinders for atmospheric gases and is based on Exemption Orders Nos. 16 and 21 to the Gas Cylinders Conveyance Regulations of 1931. The specification lays down the quality and composition of the steel and its heat treatment, requirements relating to the hickness of the cylinder walls, and a series of mechanical and pressure tests. Copies of this specification, B.S. 1045, can be obtained from the Institution, price 2s. 3d. post free.

NEW USES FOR NICOTINE

Increased demand for nicotine insecticides, brought about by the shortage of Oriental pyrethrum and derris, has led to the development in America of a new series of double salts of nicotine. These are characterised by very low solubility, extreme fineness of division, and the presence of a heavy metal, such as copper. Other uses found for nicotine in the Research Laboratory of the U.S. Department of Agriculture are nicotine-dye combinations for impregnating fibres, and dusts of rubber and synthetic plastics containing up to 10 per cent. of nicotine. Departmental chemists are now looking for improved methods of oxidising nicotine to nicotinic acid, preferably with methods involving atmospheric oxygen and a catalyst. Some success has already been obtained with a vanadium oxide catalyst.

Dust-Determination Advances

An Estimate of the Available Instruments

by S. C. BLACKTIN, Ph.D., M.Sc.

AMONG the various instruments for the determination of dusts and aerosols by count of their particle contents, four—the Konimeters, Owen's Counter, and the Settlement Counter—have a fixed relationship between the volume sampled and the particle-deposition (record) area, which is unitary and fixed; two—the Impinger and the Electric Precipitator—have no necessary relationship between volume and record area, which is also unitary and fixed; and one—the Electrotor Meter—has a mechanically-variable relationship between volume and record area, which is multiple and rotating. Consequently, the first four express their respective inefficiencies in recording (a) particle range, (b) agglomeration, and (c) particle-splitting, by reason of the agglomeration or superposition of some particles over others on their deposition (record) areas; the two in the second group express relatively few such inefficiencies on their record areas, though, manipulatively introduced, the inefficiencies themselves are probably not less; while the last one can avoid the inclusion of such inefficiencies owing to the advantages of its multiple and rotating record-area technique. All the above instruments remove the particles from their dispersed condition before they are counted. The Ultramicroscope, which is the only known instrument not performing this separation first, is not now included, but referred to later.

Operation Inefficiency

Agglomeration and superposition inefficiency is certainly the most serious and general defect of particle-determination instruments, and anything which removes it represents a valuable and far-reaching advance in scientific technique and the truth of important scientific data. The chief criteria which determine whether and to what extent such inefficiencies shall occur, are the volume of dispersion sampled, V, the particle-deposition area, X, and the conditions imposed on the particles contained in V when removed from the three-dimensional sol state to the two-dimensional gel state, on X. An additional most important function determined by these factors is the extent of particle number variation per unit volume of dispersion from unity and upwards of which an instrument is capable of providing count, *i.e.*, the range. If a dispersion of 10^7 particles per cc. is taken as the range of the Ultramicroscope, the degree of defection from that value of any instrument may be regarded as its range inefficiency. When V and X are both fixed—as with the first four instruments—the inefficiencies can be calibrated by reference to a standard, say the Ultramicroscope, but they cannot be eradicated from their specific instrument operation, though V is slightly variable in the two Konimeters. In the Electrotor Meter where X is variable widely and at discretion as well as V, the inefficiencies can be initially excluded.

Since the values of X and V are of such fundamental and general importance in such instruments, the factors merit expanded consideration.

Area of Record

1. (*a*) *Fixed area.* This varies as follows amongst the instruments which employ it, *viz.*: Konimeters, 0.28 sq. mm.; Owen's Jet Counter 10 sq. mm.; Settlement Counter, 100 sq. mm. All approximate, as records may slightly vary.

(*b*) *Fixed area (repetitive sampling).* Repetitive sampling may be used with some Konimeters and a recent American modification of Owen's Counter. The area is the same as without repetition, but the record on which particles are deposited is large enough to receive, with spaces between them, the particle contents of successive samples separately. A succession of what are intended to be identical samples, as regards V and X, is formed on the same record. The advantage over 1(a) is that, say, 30 or less samples may be recorded without moving the record, *i.e.*, the advantage of convenience and time-saving without varying the ratio V/X.

2. (*a*) *Variable area.* This is used in the Electrotor Meter. Though the ability to vary X is extremely valuable, as its inclusion should not destroy the practical advantages of maximum portability and convenience which are also attributes of the Electrotor Meter, it requires to be achieved in minimum space. It has therefore been included in two ways in space of the order of that required for merely fixed records under 1(a) and 1(b). These are (i) the choice of various spaces of different area usable separately or in various combinations, combined with (ii) the tracing-out of each such space (except the central spot area) from numerous continuous smaller sections successively covered with particles from the particle ingress, to form a regular deposit.

(*b*) *Variable area (repetitive sampling).* This is also included in the Electrotor Meter as resulting from the same principle that provides variable area. As it is additional to its single sampling, weight sam-

pling, and micrometer sampling,[1] the repetitive sampling constitutes a fourth function of that instrument. The advantages of this particular function are the same as those with fixed area instruments but in the meter about 50 successive samples may be made, if desired. The ratio V/X from sample to sample may, however, be constant or variable as desired. The principle which secures the advantages of variable area = X is that of a rotating deposition-area record combined with fixed particle ingresses at different distances from the centre of record rotation. This contrasts with the fixed-record, single-ingress, combination of the instruments under 1(a) and 1(b).

Rotating and Fixed Records

A contrast of performance indicates the advance achieved by a rotating record, whose mechanism is elsewhere described.[2] The particle stream may be supposed to arrive, for deposition in successive strata. Thus on fixed records before reaching the particular range limit, while many particles will be superposed and all will be superposed beyond that limit, the particles are laid as a continuous countable deposit, without any such range limit, on rotating records, thanks to the correlation of the rotation speed and the particle strata arrival speed. It will be realised that the significance of superposition is the destruction of microscopic countability, hence of true dispersion determinability.

Consider a circular ingress of e mm., radius and a cross-section area of πe^2 sq. mm. If each stratum is filled with particles and the strata emerge from the ingress to the record at $2em$ mm. per second; the distance between strata is $1/m$ mm.; and the speed of movement of the rotating record under the ingress is $4e^2m^2$ mm. per second; while the number of particle strata is not greater than L=circumference of particle record circle in mm./$2e$ mm.; then particle superposition cannot occur at all.

Typical Examples

Thus for an ingress of 1 mm. cross section, strata 0.5 mm. apart, and a particle deposit circle on the record of 100 mm. circumference, a speed of 4 rotations per second would be required for fully occupied strata. But if the strata are not filled—probably the general case—the rotation speed would become $2m^2y/\pi e$ mm. per second, where y = total cross-section of mean number of particles per stratum. But this assumes the particles to be all close together. If on the other hand all the particles are separated, $2m^2y/\pi e$ would become $2m^2y/\pi en$, where n = mean number of particles per stratum. While, therefore, rotation speed of $4e^2m^2$ mm. per second would prevent record superposition in all cases, including that of packed strata, in most cases it could be so low as $2m^2y/\pi en$. The circle circumference $2e$ m = L, can have any reasonable value.

Contrast the above with the particle-deposition area of πe^2 sq. mm. such as a fixed record of ingress cross-section area also πe^2 sq. mm., may reasonably possess. There will be L-1 superposed particle layers; a total particle count of merely one-Lth the *actual* number in the dispersion sample; and an instrument inefficiency of L-1/L. For example, with 100 particles per stratum able to just cover πe^2 sq. mm., and, say, 20 strata, *i.e.*, L = 20, while a rotating record will make countable practically 2000 particles at 100 per cent. efficiency, a stationary or fixed record will make countable only 100 particles, superposing 1900, with an inefficiency of 95 per cent., hence an " efficiency " of 5 per cent. only, and a range of but 100 particles. This phenomenal contrast persists for any value of $L > 1$, and for any number of particles per stratum, *i.e.*, any particle size.

It is shown later that not more than one complete rotation need be employed for count sampling, but even if it were, resultant superposition would occur only to one-Lth the extent of its occurrence with a fixed record sampling the same dispersion.

Maximal Range

The definition of range and its dependence on the ratio V/X are mentioned above. Of the four fixed record instruments the Settlement Counter has a maximal range similar to that of the Ultramicroscope. But it is necessary to distinguish carefully between the extent of range efficiency and the count efficiency at different points thereof—especially with the Settlement Counter—which can easily be confused. Thus, a range stretching to a final countability of as many as 10^7 particles per cc., as in the Ultramicroscope, might be achieved, without every step in it from, say, 10 particles per cc., having equal count efficiency. Thus, although the fixed-record Settlement Counter has so relatively low a value for V/X that its range is maximal, its ratio V/X is rigid, and cannot be varied by provided adjustment. To achieve universal particle countability, at constant count efficiency over any full range, V/X must be inversely variable as the particle content of the dispersion increases or decreases.

The Electrotor Meter would have been saddled with the same failure due to rigidity of V/X, in spite of its rotating record and the consequent maximal order of range and exclusion of superposition and agglomeration inefficiency, had it been necessary with it to employ every particle ingress on every sampling occasion; instead of, as is actually the case, incorporating a free selection of separate ingresses or some combination thereof. To carry these advantages of non-rigidity of V/X to the limit of extreme effi-

ciency at the lower end of the range, since the area of the smallest annular circle mechanically usable might be still too great for the very lightest dispersions, an ingress was included over the centre of rotation of the record. This provides a smallest deposit area similar only to the cross-section area $=\pi e^2$ sq. mm., of each ingress—a spot area, not an annular ring like the larger areas. Except that the deposit is rotationally laid on this spot area, its relation, in principle, to the ingress over it is thus exactly the same as that of the fixed-record instruments. For this spot area the ratio V/X therefore has highest value, as contrasted with the annular areas.

These important new advances of universal range—so that practically all variations of dusts, fumes, smokes, and aerosols are made easily countable and determinable; mechanically achieved with maximum economy in the Electrotor Meter, have been calculated as regards their theoretical and practical extent of the choice of selections.[3]

Volume of Sample

1. *Sample volume, Economy and Accessories.* Economies of space, portability, weight, cost, and time of operation constitute new advances in the practice of particle determination, but such advances are necessarily prevented when the main sampling unit requires to depend for its operation on accessory units. All the instruments so far discussed—the Konimeters, Owen's Counter, Settlement Counter, and Electrotor Meter, are free from such burdensome accessories. Excepting the Electrotor Meter these instruments also employ fixed volumes of sample (two volumes in the Konimeter) for determination, both absolutely and relatively to the deposit area, *i.e.*, the ratio V/X is fixed. In the case of the Electrotor Meter this ratio, as shown, is variable, hence the sample volume is relatively, unfixed.

Instruments necessitating accessories include the Impinger, the Electric Precipitator, and the Thermal Precipitator. In every case the record area X is fixed, and the sample volume V is variable. Although, in these three instruments the volume variation exists because the particle-freed gaseous sample is not exhausted into a small chamber, there is the serious disadvantage that the sampling period increases directly as the volume sampled, because the volume variation is absolute. In the Electrotor Meter, however, the same short sampling period only is required however the ratio V/X is varied, because this represents the valuable advance of relative volume variation, as distinct from absolute variation.

The Impinger and the Electric Precipitator, employing no exhaust chamber at all, can, subject to sampling-time increase, sample indefinite volumes, but the Thermal Precipitator, employing a relatively large exhaust chamber—which is a water aspirator requiring re-charging—can only vary the volume to a quite limited degree. With the Impinger the record is fixed in a figurative sense only, it having a fixed volume of liquid in which the deposited, impinged, particles are redispersed. The Electric Precipitator has so large a fixed record that the deposited particles need to be washed from it so that a small volume of the resultant suspension may be sampled. Advances in instruments burdened with accessories are: (a) a modified, more portable form, of the Electric Precipitator[4], and (b) a projector to throw the particle images × 1000 diameters on to a ruled, transparent screen.[5]

2. *Fixed Volume.* As shown, the concomitant of the fixed-area record is inefficiency due to particle agglomeration or superposition; and above various particle numbers per unit volume for various instruments, such inefficiency is completely destructive of function, whether the instrument has fixed volume or absolutely varying volume. Even below these respective limits, the fixed record makes some superposition almost inevitable, though its proportion (expressed as a percentage of the real number) is unknown and difficult of calibration because of the unpredictable factor of how dispersions will differ. Within the respective limits, the degree of this superposition will obviously vary with the variability in absolute volume sampled (on the fixed record), the degree of superposition varying directly as the volume sampled.

3. *Volume relatively variable.* This, as indicated, is achieved with great and new advantages in two ways. The distinction from absolute volume variability—with which sampling time directly varies—may be made clearer if it is stated that absolute volume variation might be attained with *any* instrument using an exhaust chamber by building that chamber of different dimensions while still retaining the fixed record area; on the other hand relative volume variation would not necessarily be so changed.

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1 BLACKTIN, S.C., *Chem. Prod.*, 1941, *4*, p. 54.
2 ID., *J. Ind. Hyg.*, 1936, *18* (9), p. 583.
3 ID., *ibid.*, 1937, *19*, (10), p. 579.
4 BARNES and PENNEY, *ibid.*, 1938, *20* (3), p. 259.
5 BROWN, BAUM, YANT, and SCHRENK, *U.S. Bur. Min.*, R.I., 1938, 3373, B. 467.

(To be continued.)

A factory for the production of alloy steels not previously manufactured in India has just been completed, it is reported from Delhi. Special steels required for India's growing manufacture of small arms and ordnance will be produced there, and a satellite factory will attend to the forging, processing, and annealing.

West African Oils

A Rich Source of Vegetable Products

ALTHOUGH French West Africa has so far remained within the Vichy fold, it is not without interest to consider its productive potentialities, especially as it is a source of many types of oil that are not very well known, as well as some that are perfectly familiar to traders throughout the world. A recent article in *Foreign Commerce Weekly* gives some pertinent details on the subject, and in present circumstances a review of these is not out of place.

It is well known that Senegal is one of the world's three largest producers of ground-nuts (peanuts); it comes after China and India, though production in the U.S.A. has been larger in some years. As exporters of ground-nuts, India and Senegal have run neck and neck, most of Senegal's exports going to France, chiefly "in the shell." The record export year so far notified was 1940 when 129,531 metric tons were exported, though the most productive year was 1937, with 708,798 tons.

Shortage of Lubricants

Local difficulties in the provision of lubricating oils have led the French Ministry of Colonies to make experiments with lesser-known types of vegetable oil, and the local Press states that these investigations have led to a distinct improvement in the grease problem. In addition to palm, peanut, kapok, and cotton oil, and vegetable butter, the following thirteen oils have have been found in the West African territories:

Oil of Orala, extracted from seeds of a tree of the Mimosa family, containing 41.6 per cent. of a light yellow oil which flows at room temperature, but which can be precipitated by stearin. It is suitable for many different applications.

Oil of Bonduc, produced from a climbing plant, known as *Guilandina Bonduc*, found in African coastal regions, useful for many purposes.

Sesame oil, from seeds 48 to 50 per cent. oil, is of primary importance for greasing purposes.

Baobab oil, a yellowish oil ordinarily solidifying at 13° C., but remaining solid at a high temperature after heat treatment, is produced with small acid content.

Niger oil is expressed from seeds of an annual plant called *Guizotia oleifera*, containing 40 to 50 per cent. oil. Under first pressing 18 per cent. of edible oil is produced; under second pressing, 14 per cent. of a brown edible oil. It is also of value as a grease.

Oil of Sudanese lettuce, extracted from seeds containing 44 per cent. oil, can serve, with technical treatment, both as an edible oil and as an industrial grease. Viscosity can be increased without polymerisation effects.

Oil of African pumpkins is produced from large seeds very rich in oil suitable for eating, cooking, soapmaking, and greasing.

Melon and cucumber oil, already exploited on the Gold Coast and Slave Coast of West Africa. Seeds contain 43 per cent. of a light yellow, odourless, sweet oil which can be used as an edible oil and as a grease.

Oil of Aoura, extracted from dates of the Guinea palm, producing 20 to 30 per cent. oil. More stable than palm oil, more resistant to alkalis and acids, it liquefies at 15° and solidifies at 4° C. Considered very satisfactory for greasing.

Oil of Toulougouna, found only on the West Coast of Africa, has a high stearic acid content, and its composition approaches that of beef suet. The acid fats are very useful as grease.

Makerow butter, extracted by solvent from seeds of a tree found on the Ivory Coast, is semi-solid and snow white, consisting solely of oleic and stearic acid. Useful as a grease.

Dika butter and Shea butter are already much employed as greases in French West Africa.

ELECTRON VACUUM PUMP

How electrons may be used to aid in the production of extremely high vacua in containers is revealed in U.S.P. 2,282,401, awarded to C. W. Hansell, of Port Jefferson, U.S.A. When electrons strike a gas molecule they ionise it or cause it to become charged. It is this ionising property on which the operation of the electron vacuum pump is based. The pump essentially comprises a modified vacuum tube linked up with the container to be evacuated In the tube a stream of electrons is shot out by an electron gun. To make sure that the electrons will ionise the gas molecules which must be removed to create a high vacuum, the tube is surrounded by a magnet. This causes the electrons to travel in a spiral inside the tube. The electrons are thus made to travel a longer distance, whereby the chances of their colliding with molecules and ionising them is increased. Ionisation of the gas molecules results in their being charged negatively; so charged, they are attracted to positively charged plates or anodes and thus removed from the vessel that is being evacuated.

The Chemistry of Cork

Industrial Research in Spain

VIRTUALLY all the cork that grows in the world is concentrated in the Western Mediterranean region, from Portugal to Sardinia and Tunis, and from the south coast of France to Morocco. The annual cork production of this area is estimated at 100 million kg. per annum, of which the Iberian Peninsula is responsible for three-quarters, say 50 million kg. in Portugal and 25 million kg. in Spain. It is not surprising, therefore, that Spanish chemists should turn their attention to the development of the cork industries with a view to increasing the national output. Professor I. Ribas, of the University of Valencia, has contributed a most interesting article on the subject to the Spanish technical journal *Ion* (1942, *2*, 6, pp. 25-8), an abstract of which follows hereunder.

The Cork of Commerce

The cork trade has depended, up to date, almost entirely on the physical properties of its product; lightness, elasticity, impermeability, low heat conductivity, and high mechanical resistance, which are the fundamentals of the cork-using industries and the very properties that Nature makes use of in creating cork as a protection for plants against drought, temperature-variations, and mechanical shock. Some few references are found in the literature to the chemical properties of cork, *e.g.*, its use in the form of cork-charcoal, which is only partly carbonised and is used (under the name of Spanish black) in the manufacture of printing inks; its employment as a tanning material; and its distillation with the production of gas and a tar from which benzol and toluol are said to have been derived.

Raw cork is the bark of the cork-oak (*Quercus suber*), which is produced spontaneously when the tree is stripped of its original bark by hand. The original bark is known as "male cork" and is of small value; the bark which the cork-oak produces as the result of the stripping process is the "female cork," the actual product in industrial use.

Structurally, cork is made up of a network of empty dead cells separated by coarse membranes. Each cell is hexagonal in longitudinal section and rectangular transversely. It is this cellular structure which accounts for the elasticity and lightness of the cork. The intercellular membranes are made up of a central portion of cellulose, more or less degraded and partly lignified, on each side of which (*i.e.*, forming the inner walls of the cells) is a layer of suberin, the fundamental structural substance of cork. So far it has not proved possible to isolate suberin chemically, although, from a histological point of view, its existence is perfectly clear. It is a combination of the chemical properties of these suberin layers with their peculiar structural arrangement which endows the "female" cork with its useful qualities.

Chemical Composition

The composition of "female" cork is approximately as follows, divided under the various heads of the types of material concerned: ash, 1 to 2.6 per cent.; tannins, 10 to 15 per cent. (separated by aqueous extraction); esters, 1.7 to 3 per cent. (separated by organic solvents, such as ether, chloroform, ethyl acetate, etc.); cellulose and hemicellulose, 8 to 22 per cent., forming an unsaponifiable residue when the cork is heated in dilute alkali after the acids have been separated out in the form of soluble salts; fatty acids, mainly of alcoholic or ethylenic origin, combined in saponifiable form, 40 to 58 per cent.; combined glycerol, also saponifiable, 2.65 to 6.2 per cent.

The fatty acids are easily extracted by hydrolysis by boiling in a 3 to 10 per cent. solution of caustic soda, and precipitating them from the alkali solutions separated from the unsaponifiable fraction by the addition of sulphuric or hydrochloric acid until an acid reaction is obtained with Congo red. It will be noted that the fatty acids in the cork are not free, as they cannot be extracted by solvents, but only by saponification methods. The author's study of the saponification value of cork, one of the several important characteristics which it possesses analogous to those of fats, was interrupted by the Spanish Civil War.

Fatty Acids

It is generally admitted that suberin is a saponifiable combination, of high molecular weight, of the fatty acids already mentioned, which are, for the most part, alcoholic and unsaturated. The chemical constitution of nearly three-quarters of these acids, however, is unknown; only 29 per cent. have so far been identified, mainly by Zetzsche and co-workers, and by Scurti and Tomasi. The most abundant of them is the phenolic acid $C_{22}H_{44}O_3$, which accounts for 15 per cent. of the total; it is a saturated, straight-chain acid, and has been identified as α-hydroxy behenic acid. Next in importance (9.9 per cent.) is suberolic acid, $C_{18}H_{34}O_2$, a saturated acid, which appears to be identical with ricinoleic acid. Phloionolic acid, also saturated, (9, 10, 18-trioxystearic acid), forms 1.7 per cent. of the total, and phloionic acid (octadecane-10-

diol-1:18-dicarboxylic acid) accounts for 1.4 per cent.; and 1 per cent. is made up of eicosane dicarboxylic acid, $HOOC.(CH_2)_{20}.COOH$. The remaining 71 per cent. of fatty acids remain unidentified. According to some investigators, saponifiable combinations of these acids, in the form of acid anhydrides or alkyl esters, are the sole constituents of suberin, and neither cellulose nor glycerol enters into its composition.

Other workers, however, incline to the view that cellulose and kindred substances do enter into the composition of the suberin molecule, by esterification with the acids. In 1929 and 1931, I. G. Farbenindustrie took out a patent for the preparation of substances analgous to cork (artificial cork), by the esterification of cellulose and its derivatives, by means of chlorides of high molecular fatty acids, or by alkyl esters, or by mixtures of these. Karrer, however, (*Helv. Chim. Act.*, 1921, *4*, 174, and 1922, *5*, 853) and Zetzsche (*ibid.*, 1928, *10*, 346 and *11*, 342) and Madinaveitia (*Las Farm. Mod.*, 1935, *46*, 327) have shown that cork acids do not esterify cellulose; in their view the cellulose simply makes up the network of intercellular partitions and acts as a support for the suberin molecule. In the author's opinion, in view of the existence among the cork acids of certain α-oxy-acids, it is by no means impossible that an unstable cellulose ester should be formed, as the ease with which the esters of α-oxy-acids hydrolyse is well known. It seems quite certain, at any rate, that if there is any combination between the acids concerned and the cellulose, it is much less stable than the customary cellulose esters.

The Nature of Suberin

As regards the glycerol content, the chemists who first engaged in research on cork considered suberin to be a fat, because it could be stained by the same dyes as fat and was saponifiable; later workers contend that it is impossible to consider suberin as a fat, because it is insoluble in fat-solvents and is also infusible or hardly fusible. It is to be regarded either as a mixture of hardly fusible esters insoluble in fat-solvents, or else a condensation or polymerisation product of cork-producing acids or their derivatives. The author and his colleagues have found a glycerol content in suberin and have demonstrated that this cannot be regarded as emanating from any fat that might be present as an impurity, since it cannot be extracted by solvents. It is combined with the acids in the form of an ester insoluble in water or in fat-solvents, but in an easily saponifiable form. The ease with which the glycerol is separated by saponification accounts for the fact that the authors who worked with purified cork did not discover it among the products of hydrolysis and therefore believed that it did not enter into the composition of the suberin.

The ease with which cork is saponified by alkalis must be remembered, and in practice ordinary cork must not be used when working with alkaline products, as these will quickly absorb impurities. On the other hand, cork is very resistant to acids, notably to concentrated sulphuric acid, though naturally only for a limited period. Cork is subject to attack by oxidising agents, as much as by alkalis, and the reaction with nitric acid, which converts cork into a disintegrated yellow mass of waxy appearance (suberic acid) is well known. The halogens are also destructive to cork. This disintegration of cork by oxidising agents is due to the abundance of hydroxyl groups and double bonds in its component molecules, the structure of which breaks down completely.

Future Uses for Cork

Prediction about the future of the various components of cork is difficult to make. For example, instead of discarding the liquor derived from the boiling of recently-stripped bark in order to soften it and flatten the rolls for convenience of transport, it might be possible to concentrate it *in vacuo* for the preparation of tanning extracts, since this liquor contains practically all the tannin in the bark. As for the esters, further study will have to be made before it will be possible to make a comparison between them and other industrial products, though this study was already started in America in 1935. Unsuspected properties may well be discovered in the fatty acids—possibly biological uses comparable with those of traumatic acid and vitamin F—while the glycerol and cellulose still remain unemployed. The author is continuing his work on the subject in the organic chemistry laboratory of Valencia University.

From another source comes the report that successful tests have been carried out by a Portuguese engineer with tyres made of cork. The invention, which it is hoped will relieve the rubber shortage, is being followed wih close interest by the authorities in view of the fact already stated above, Portugal is a leading cork producer.

The Minister of Fuel and Power, opening a fuel-saving exhibition at Guildford last week, said that if every household in the country saved 2 lb. of coal each day in the seven winter months it would mean saving 2,000,000 tons, and if one 60-watt bulb in every house was put in a drawer that would save 320,000 tons of coal in the same period. He firmly believed that we could avoid rationing, and by voluntary appeal would be able to see this winter through by saving unnecessary waste.

Personal Notes

PROFESSOR HAROLD SIMMONS BOOTH has been appointed chairman of a reorganised Department of Chemistry at the Western Reserve University, U.S.A.

MR. H. E. AIREY has been nominated to The Gas Light and Coke Company's gas research fellowship at the Imperial College of Science and Technology as from October 1 next.

COLONEL ROYAL LORD is to be head of the Office of Technical Development which has been set up in the United States to act as a clearing-house for technical and scientific progress throughout the entire group of United Nations.

MR. STEPHEN M. SHELTON, metallurgist of the U.S. Bureau of Mines, an authority on the recovery and processing of ores, has been appointed Regional Engineer for the Eastern and Southern States, with headquarters at College Park, Maryland.

MR. JOHN V. MULLER was elected president of the Chemical, Metallurgical, and Mining Society of South Africa at the annual meeting held in Johannesburg recently. Mr. Muller, who succeeds Mr. Theo. Meyer in the presidential chair, is consulting engineer of New Consolidated Goldfields, Ltd.

MR. S. HENSHAW, F.I.C., has retired from the position of chairman of the National Benzole Company, Ltd., which he has held since the formation of the company about twenty-three years ago. He will, however, retain his seat on the board. MR. J. H. OLLIVER, who has been a director of the National Benzole Company since its inception, has been elected to succeed Mr. Henshaw as chairman.

NEW ANIMAL PRODUCT COMPANY

Fabon, Limited, registered on August 14 as a private company limited by guarantee (375,546) without share capital, but with an unlimited number of members—each liable for £5 in the event of winding up—has been founded to make and give effect to any scheme for concentrating or rationalising the technical fat-producing and bone-using industries. It is to make arrangements with the Ministry of Food. Members are classified under two headings. "Nucleus manufacturers" are those who, in pursuance of any concentration scheme continue actively to produce any of the manufactured commodities as defined in the Rules of Association. All other members are "dormant manufacturers." The first members of the management committee are mostly directors of companies connected with the manufacture of chemicals from animal products.

Ammonium Bifluoride

Precautions to be Taken

AMMONIUM bifluoride crystals contain an equivalent of about 33 per cent. hydrofluoric acid. This material should therefore be handled as carefully as hydrofluoric acid, for it can produce painful burns that are slow to heal. In pointing out this fact, the American magazine *Chemical Safety* outlines the risks involved in handling the material and suggests precautions that should be taken. The risks, says the writer, are burns caused by prolonged contact with the skin from crystals; by contact of the crystals with sores, cuts or other openings in the skin; under the finger nails in removing dried material from clothing; and by contact of any part of the body with the solution of ammonium bifluoride.

The following precautions should be taken: (1) Always wear rubber or rubber-impregnated gloves when handling the crystals or solution; (2) wash gloves inside and outside before and after use, starting with the outside before removal; (3) flush with water for ten minutes before going to the dispensary, if material comes in contact with the skin. If the eye is affected then flush with a gentle stream of water—the quicker the flushing is begun the less the chance of a burn; (4) always flush well with water if you are suspicious of a contact with this material; (5) suitable goggles should be worn at all times.

Mixed Chlorides for Sugar Beet

Fertiliser Tests

A MIXED fertiliser in the form of chlorides has emerged as the most satisfactory in sugar-beet cultivation during a series of tests conducted in Belgium in the past five years, on mixed fertilisers containing potassium and sodium salts. Use of sodium chloride alone or of sodium carbonate or sodium sulphate alone, or combined with potash, did not give as good results, it was said, in either sugar content of the beet or the total sugar yield. Soda in the mixed fertiliser tended to increase resistance of the beet to disease, without harmful effect on the soil. Further tests have indicated that simultaneous application of sodium and potassium compounds in the form of pure salts results in a twelve per cent. increased sugar yield, compared with a seven per cent. increase from potash alone. Soda is particularly beneficial in light, sandy soil. Fertilisers containing soda are recommended in the report for sugar-beet districts where leaf yellowing disease is prevalent.

General News

Importers' inquiries and applications (in duplicate) in respect of essential oils should, from August 31, be addressed to the Ministry of Food, Fruit Juices, Essential Oils and Pectin Branch, Portman Court, Portman Square, London, W.1.

The Board of Trade has, with the approval of the Treasury, decided that, in respect of the period beginning September 3, and ending December 2, 1942, the rate of premium payable under any policy of insurance issued under the Commodity Insurance Scheme, shall continue to be at the rate of five shillings per cent. per month.

Recent investigations carried out by the Imperial Institute on the properties of po-yok oil from Sierra Leone (originally examined in 1918) indicate that this oil has valuable varnish- and paint-making qualities. It is of the same type though not as useful as tung oil, but its properties are generally superior to those of linseed oil.

At the Government's request, a specification has been prepared by the British Standards Institution to provide paint to replace oil paints. Some of the paints specified are complementary to, and not necessarily wholly in substitution for oil paints. In the national interest these substitute paints should be used wherever possible.

Processes recently devised to give unshrinkability to wool were the subject of Professor J. B. Speakman's address to the Huddersfield Section of the Association of Dyers and Colourists, last Tuesday. New processes which did not attack the wearing quality were described, which functioned only by attacking the outside of the fabric and forming a rubbery film on the outer surface.

A third impression of the fourth edition of the "Technical Data on Fuel" has now been published by the British National Committee of the World Power Conference, and copies can be obtained from Mr. M. W. Burt, manager and secretary, Society of British Gas Industries, Uplands, Epsom Road, Guildford, Surrey. The price remains unchanged at 12s. 6d. net (postage 6d.).

Some indication of the increasing industrial use of silver is afforded by the speech of Mr. Mackinnon, Dominion Minister of Trade, explaining the need for the Canadian embargo on the export of silver. Industrial consumption of silver rose, in the U.S. and Canada, from 40 million oz. troy in 1940 to 80 million in 1941. As a brazing alloy in aircraft and tank construction, as a soldering material in conjunction with lead and tin, and in other combinations for conducting electricity and heat, the use of silver has increased enormously.

From Week to Week

The Ministry of Food announces that any factory which provides washing facilities for its employees in compliance with the Factory Acts may be authorised to obtain an allowance of one ration of soap per four-weekly period in respect of each factory employee. If the washing facilities take the form of baths two rations instead of one may be obtained.

A campaign for the salvage of ten million old gramophone records has been started by the British Legion, in order to make up for the scarcity of imported shellac. Ten-inch and 12-inch discs in good condition are required, which should be delivered to the nearest British Legion depot (of which there are 6100). The King has already presented a number of records from his private collection.

The waste of good chemicals, and the considerable damage done to wool through staining, was deplored by Major Mark Sprot, president of the Scottish Agricultural Organisation Society, at their annual meeting in Edinburgh. Appeals had been made by Scottish Wool growers and other bodies for at least 15 years, he said, but with no result. In the marking of sheep at collecting centres, the Ministry of Food was one of the worst offenders.

Foreign News

All chlorine used by municipal and other water-purification plants in India during the past year was produced locally, according to an official statement.

For an investigation into the extraction of copper from its ores by the iodine process, the Compañia Yoduradora de Cobre has been granted a loan by the Government of Chile.

An additional group of more than 750 enemy-owned patents, among them about 200 patents of I.G. Farbenindustrie not previously vested, have been seized by the Office of the Alien Property Custodian in the U.S.A.

Plans for a nitrogen fixation works in Denmark are believed to have been made. Under this programme a power plant, a coke oven, and a direct ammonia production unit are to be built at a cost of £10,000,000.

The possibility of converting phosphate rock, found in quantity in South Africa, into soluble phosphate fertiliser, is being studied as part of a general programme to develop native base mineral resources.

The Palestine government will undertake to produce locally 12,000 tons of superphosphate annually. An order has been placed abroad for an amount sufficient to take care of immediate requirements until full production is reached.

A steel plant to be constructed at Monclova (Coahuila), Mexico, is to be assisted by a loan of $6,000,000 from the U.S. Export-Import Bank.

Negotiations are reported to have been renewed between the governments of Egypt and Russia for exchange of Egyptian cotton for 50,000 tons of sulphate of ammonia.

Plans for exploiting, under national restrictions, what are believed to be extensive mica deposits are reported from New Zealand. Deposits are stated to cover an area of 89 square miles at elevations of 4000 and 5000 feet.

Production of solvents and chemicals from southern pine wood is believed sufficient to meet the wartime needs of the rubber reclaiming industry in the U.S.A., Charles A. Higgins, president of Hercules Powder Company, has announced.

The President of the Nitrate Sales Corporation states that 700,000 tons of Chilean nitrate reached the U.S.A. in the year ended June 30, 1942, and that it was hoped to duplicate this amount in the next twelve months, notwithstanding shipping difficulties.

The discovery of methane deposits in the Po Valley and near Bologna has resulted in the extended use of this gas as an industrial fuel in Italy. Locomotives on the Rovigo-Chioggia branch are quoted as being fired by this means.

A modern plant for the utilisation of mica is being erected by German interests in the Prilep district of Serbia. When completed, it will employ 1500 men in the mining and treatment of the material, which was formerly exploited by primitive methods.

Optimistic reports about manganese and copper have been received from Coquimbo and Antofagasta (Chile) and in June the exports of mineral products from Antofagasta and from the neighbouring port of Mejillones included some 23,000 tons of electrolytic copper, 8000 tons of tin ores, 3000 tons of zinc ores, and 2500 tons of antimony ores.

Drilling for oil is being resumed this month at Hollviken, at the southern tip of Sweden. Operations were interrupted last December when the equipment was found to be inadequate at a depth of 3640 ft. It is hoped that oil-bearing shale layers will be found at 5400 ft. where the strata are said to range from 490 to 660 ft. in thickness.

The production of zinc from scrap and residues is to be undertaken by A/B Glücksmans Metallaffär in a disused cyanide factory at Trollhättan, which has been bought from the Swedish Government. About 5000 tons of scrap zinc, hitherto exported from Sweden every year, will be treated in the plant, and zinc white and grey and ammonium chloride will also be produced. Zinc ores will subsequently be treated at Trollhättan.

The Zellstoff-fabrik Waldhof of Mannheim has been experimenting with the use of sulphite lye as a binder in the production of fuel briquettes, according to Press reports. The tests have not been concluded but promise good results, it is stated.

South Africa is supplying the United States with manganese, tungsten, chrome, and other metals, the Union Minister of Mines, Mr. Stallard, has stated, according to a report from Johannesburg. The Department of Mines, he said, was searching intensively for deposits of tungsten and tin.

South Africa is wasting £800,000 worth of recoverable lubricating oil every year, according to a writer in the *South African Mining and Engineering Journal*. He advocates the erection of three small refineries for recovering used oil, each capable of refining about 1½ million gallons per annum; these, he claims, would recoup the entire cost plus operating expenses in under six months.

Forthcoming Events

On **August 26,** at 4 p.m., at the Imperial Institute, South Kensington, there will be a conducted visit of the London and S.E. Counties Section of the **Institute of Chemistry** to the Exhibition galleries (tea and film-show included). Only 50 members can be accommodated. Application should be made to the Secretary, and a ballot will be held. Applicants securing places will be informed of their good fortune.

The first meeting of the **Electrodepositors' Technical Society,** in the session 1942-43 will take place in Birmingham on Tuesday, **September 1,** at 6 p.m., at the James Watt Memorial Institute, Great Charles Street, when the chairman of the Midlands Centre, Dr. S. Wernick, will deliver an address on "The Trend of Metal Finishing Development."

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

BRITISH CELANESE, LTD., Torquay. (M., 22/8/42.) July 28, £57,000 and £17,000 debenture stock, parts of amount already registered. *£2,786,481. December 31, 1941.

Satisfaction

ALUMINITE & ALZAK, LTD., London, W., metallurgists, etc. (M.S., 22/8/42.) Satisfaction July 31, of mortgage registered January 10, 1941.

Bankruptcy Information

KOHN, PAVEL, 9 Florence Court, Maida Vale, London, Doctor of Chemistry. (R.O., 22/8/42.) First meeting August 21, 1942, 11 a.m.; public examination September 22, 1942, 11 a.m., both at Bankruptcy Buildings, Carey Street, London, W.C.2.

Chemical and Allied Stocks and Shares

SENTIMENT in Stock Exchange markets has been assisted by the Prime Minister's Moscow visit and by the more hopeful views now current in regard to the latest war developments. There was some improvement in the volume of business, but in many directions the rise in values was out of proportion to the demand experienced, many stocks and shares having remained in very limited supply in the market.

Imperial Chemical reflected the better trend with an improvement on balance from 32s. 10½d. to 33s. 1½d. but, at the time of writing, Lever & Unilever have remained unchanged at 28s. 6d. British Aluminium were better at 44s. 3d., as were Borax Consolidated at 33s. 3d. British Oxygen improved to 66s. 3d. awaiting the interim dividend announcement, while elsewhere Dunlop Rubber had a better appearance at 28s. 3d. In other directions, Imperial Smelting rallied slightly to 11s. 6d., and a further rise from 11s. 7½d. to 12s. 10½d. was recorded in the 10s. shares of General Refractories. British Plaster Board were again active and were 26s., while Associated Cement improved 1s. 3d. to 50s. B. Laporte were firmly held and inactive, and remained quoted at 66s. 3d., while Fison Packard were again 31s. 1½d. Goodlass Wall further improved; these 10s. shares changed hands up to 11s. 7½d. Monsanto Chemicals 5½ per cent. preference shares continued to be quoted at 22s. 6d. Business up to 45s. was recorded in W. J. Bush shares, which remained very firmly held, aided by the good impression created by the recently-issued results.

Numerous iron and steel issues improved, attention being drawn to the apparently attractive yields. Dorman Long were 19s. 9d., Allied Ironfounders 34s., Babcock & Wilcox 43s. 6d., Stewarts & Lloyds 47s. 1½d., Staveley 43s., Tube Investments 85s. 3d., and United Steel 23s. 9d. In other directions, textile issues have been favoured on the assumption that the improving trend in earnings may be continued. Awaiting the financial results, Bradford Dyers were better, as were Calico Printers. Shares of companies associated with plastics were again active; British Industrial Plastics 2s. ordinary transferred up to 4s. 10½d., while Erinoid 5s. shares further improved, business up to 11s. 3d. having been recorded at the time of writing. Lacrinoid Products 2s. shares were around 4s. 9d.

British Glues & Chemicals 4s. ordinary were quoted at 6s. 3d.; business at 29s. 3d. was "marked" in the participating preference shares. Low Temperature Carbonisation 2s. shares were slightly lower at 1s. 6½d. but are now "ex" the dividend. Improvement from 67s. 6d. to 68s. 6d. was recorded in Turner & Newall, while Barry & Staines further improved from 32s. 6d. to 33s., and Nairn & Greenwich remained steady at 51s. 3d. Elsewhere, Lawes Chemicals transferred between 7s. 6d. and 9s. The units of the Distillers Co. were higher at 78s. 9d. United Molasses 6s. 8d. units were quoted at 28s. 6d. Boots Drug 5s. ordinary were 36s. 3d., while Sangers 5s. shares, which remained under the influence of the financial results, were 17s. 3d. awaiting the dividend announcement. Timothy Whites were 22s. 10½d. while in advance of the interim dividend statement. Beecham Pills deferred shares improved slightly to 12s. 4½d. Greeff-Chemicals 5s. ordinary were around their par value. British Drug Houses transferred up to 18s. 3d.

Paint shares again moved higher, with International Paint 102s. 6d. compared with 98s. 9d. a week ago. Indestructible Paint around 85s., and Lewis Berger around 55s. Hopes that the forthcoming results may permit some improvement in the dividend were reflected by a rally to 32s. 4½d. in Triplex Glass. British Match remained firm and unchanged at 34s. 6d. At 27s. 9d. the units of Wall Paper Manufacturers were within 3d. of the level ruling a week ago. There was only a small volume of business reported in oil shares, but better prices ruled for Anglo-Iranian, "Shell," and other leading issues in this section.

British Chemical Prices

Market Reports

THERE has been no apparent falling off in the volume of inquiry in the general chemicals market during the past week and most sections of the market report a fairly active demand. Makers' deliveries against contracts have been steadily maintained and the movement into consumption in the aggregate has been substantial. In the acid section, oxalic, tartaric and citric continue to be absorbed in good quantities. Among the soda products an active inquiry is circulating for hyposulphite of soda and values for chlorate of soda and yellow

prussiate of soda are strong on a tight market. There is no change in the position of potash products, supplies remaining rather short with values firm. The coal tar products market remains steady with a firm undertone. The movement has again been good with deliveries of carbolic and cresylic acid and creosote oil continuing on a good scale. The market for pitch has not been particularly active, and moderate business has been transacted in the pyridines.

MANCHESTER.—Holiday interferences with contract deliveries of chemicals have been rather less in evidence on the Manchester market during the past week and, on the whole, the movement of supplies is satisfactory, with a fair call for a wide range of textile chemicals from Lancashire and Yorkshire users. New bookings during the week have been on a moderate scale, while a fair number of additional inquiries are being dealt with. With regard to prices, these are strong in virtually every section, though, compared with last reports, there has not been much actual change. In the by-products market, pitch, pyridine, xylols, and solvent naphtha are the least spectacular sections of an otherwise active trade.

GLASGOW.—In the Scottish heavy chemical trade during the past week there has been some improvement for general chemicals for the home trade. Export trade has still been very quiet; prices continue very firm. Prompt deliveries are becoming more difficult.

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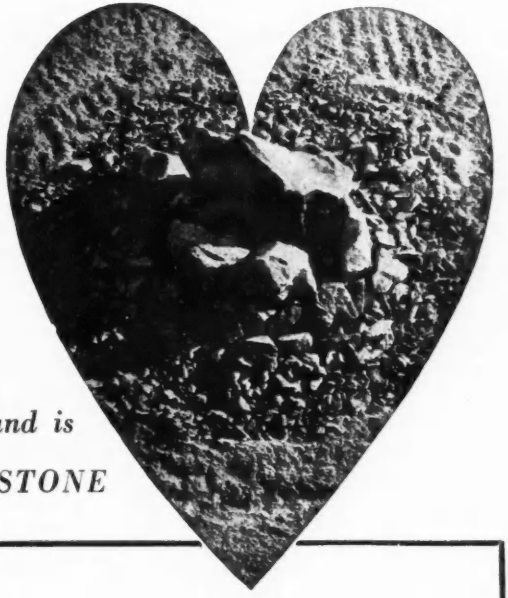

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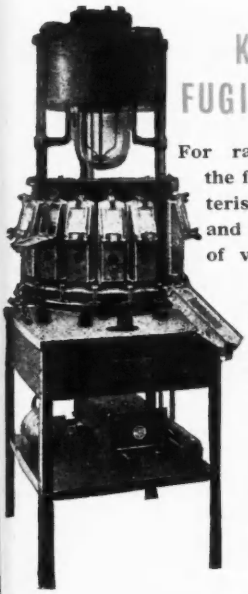

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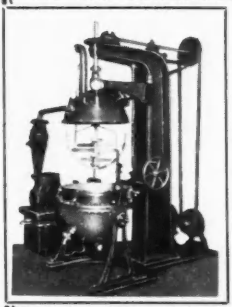

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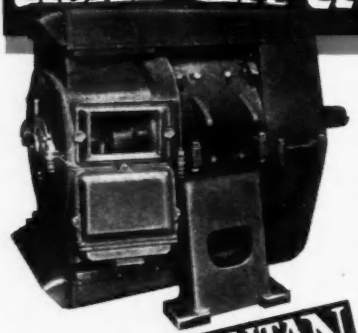

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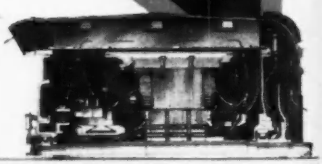

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